SCIENTIFIC PAPER

Adult Stentless Laparoscopic Pyeloplasty

Arieh L. Shalhav, MD, Albert A. Mikhail, MD, Marcelo A. Orvieto, MD, Ofer N. Gofrit, MD, Glenn S. Gerber, MD, Kevin C. Zorn MD

ABSTRACT

Background and Objectives: Pyeloplasty, whether open or laparoscopic, has been the mainstay of treatment for ureteropelvic junction obstruction (UPJO). A nonstented pyeloplasty has only been reported in the pediatric literature. Herein, to the best of our knowledge, we report the first published experience with laparoscopic stentless pyeloplasty (LSP) in the adult population.

Methods: Patients with a normal contralateral kidney who underwent a laparoscopic pyeloplasty were included in this study. A dismembered pyeloplasty was performed without the placement of a ureteral stent. Functional Tc-99m MAG3 renal-scan data were compared with results at 4 weeks and 6 months postoperatively. Perioperative complications and long-term follow-up were prospectively gathered.

Results: To date, 5 patients have undergone LSP with a mean follow-up of 15.7 months. Mean age and body mass index of this group were 42.8 years and 29.3 kg/m^2, respectively. Mean operative time, estimated blood loss, and hospital stay were 196 minutes, 58 mL, 1.6 days, respectively. Three patients had right-sided UPJO, and 2 patients had left UPJO. No patient had undergone previous surgery for UPJO. All patients had a ureteral stent in place at the time of surgery. No intraoperative complications occurred. Only one patient complained of flank pain on POD1. No obstruction or urinary extravasation was seen on retrograde pyelography, but a ureteral stent was placed. During our follow-up, all patients had complete resolution of their symptoms. Postoperative renal scans demonstrated improved urinary drainage in all patients.

Conclusion: Our initial experience suggests that in experienced hands, LSP may be an effective method for treating UPJO.

Section of Urology, University of Chicago Pritzker School of Medicine, Chicago, Illinois, USA (all authors).

Address reprint requests to: Kevin C. Zorn, MD, University of Chicago, Department of Surgery/Section of Urology, 5841 S Maryland Ave MC 6038, Chicago, Illinois 60637, USA. Telephone: 773 834 9889, Fax: 773 702-1001, E-mail: kevinzorn@hotmail.com

Key Words: Stent, Laparoscopic, Pyeloplasty, Ureteropelvic junction obstruction.

INTRODUCTION

Over the last century, the surgical management of ureteropelvic junction obstruction (UPJO) has dramatically evolved.[1] Various open surgical techniques have been described based on the cause, location, and length of the UPJO. The most popular repair is the Anderson-Hynes dismembered pyeloplasty, which has universal application and is accepted as the gold standard of treatment.[2–5]

With the development of endoscopic techniques and equipment, minimally invasive approaches have come into favor in the treatment of patients with primary and secondary UPJO. A variety of endoscopic treatments via antegrade and retrograde approaches have been described.[6–12] More recently, with advancing laparoscopic skills and the introduction of robotic-assisted surgery, many centers have moved to laparoscopic pyeloplasty (LP) as first-line therapy.[13–27] Improved suturing skills and the use of robotic assistance have greatly facilitated laparoscopic dismembered pyeloplasty for primary and secondary repairs.

The use of ureteral stents following pyeloplasty ensures adequate drainage, particularly in the presence of postoperative edema. For similar reasons, stents are commonly used after ureteroscopy–although some controversy still exists regarding its necessity after uncomplicated ureteroscopic stone removal.[28] In the pediatric population, stentless pyeloplasty has been found to be safe.[5] The advantages of stent placement following pyeloplasty include lowering the risk of urinoma formation following UPJ repair[5] and providing support and alignment of the fresh suture line.[29] The importance of the stent is highlighted when the anastamosis is not watertight, or after endopyelotomy, allowing healing of the defect while urine is diverted by the stent. However, ureteral stents are not free from risk, and potential problems include migration, encrustation, retained or forgotten fragments,[30] irritative urinary symptoms, exposure of the upper urinary tract to high pressure during urination, flank pain, and increased

risk of infection.[31,32] In a porcine model, Soria et al[33] evaluated whether it is possible to reduce the duration of ureteral stenting following endopyelotomy, and thus reduce side-effects. Ureteral stent placement for 1 week was found to be insufficient to assure correct healing and evolution of the UPJ following endopyelotomy. Stenting for 3 weeks was shown to be effective, and it was therefore not necessary to extend stenting time to 6 weeks.

In the senior surgeon's experience (ALS), 17 stented LPs have been performed to date. Excellent outcomes have been previously reported with the use of the LapraTy clip during collecting system reconstruction.[17] Although the role of stents has been well described after endopyelotomy, its role after laparoscopic pyeloplasty, where watertight closure can be achieved, is unclear. We report our initial experience with laparoscopic stentless pyeloplasty (LSP).

METHODS

This is an Institutional Review Board approved, prospective collection and retrospective analysis of data obtained from patients specifically undergoing LSP. Between November 2004 and February 2006, 6 consecutive patients were treated without the placement of a postoperative stent, all of whom were operated on by the same surgeon (ALS). One of these patients underwent a ureterocalicostomy and was excluded from the analysis. All patients had documented UPJO by Tc-99m MAG3 renal scintigraphy. In addition, all patients had undergone retrograde ureteral stenting by their local urologist before being seen at our center.

All patients underwent a transperitoneal laparoscopic dismembered pyeloplasty, as previously described.[17] Briefly, after cystoscopy and ureteral stent removal followed by repeat retrograde urography, patients were placed in a lateral decubitous position. After port placement, the colon was reflected medially followed by identification of the ureter either at the level of the lower pole or near the level of the renal hilum. The ureter was dissected until the area of obstruction was identified. The collecting system was divided just cranial to the narrowest point, and the ureter was then spatulated 2 cm along its lateral aspect. The capacious pelvis was minimally spatulated along its medial aspect and reduced appropriately if excessive tissue was present. The anastomosis was performed using 4–0 absorbable Vicryl suture on an SH-needle beginning with the posterior layer with a free hand-tied knot and proceeding with a continuous suture in a lateral-to-medial direction. The suture line was performed by placing the needle from outside-to-in on the renal pelvis and inside-to-out on the ureter side. A Lapra-Ty clip (Ethicon Endo-Surgery, Inc., Cincinnati, OH) was used to complete the suture line at the medial aspect of the renal pelvis. The anterior layer was completed in a similar fashion by using a second 4–0 Vicryl suture secured with a Lapra-Ty clip. A transperitoneal drain was placed along with a urinary catheter in the bladder. Forced diuresis along with intravenous indigo-carmine was provided by the anesthesia team to visually inspect the anastamotic closure.

On the morning of postoperative day (POD) 1, the bladder catheter was removed, and the drain was removed 12 hours later before hospital discharge, after the patient had voided without any increase in drain output. All patients had a follow-up Tc-99m MAG3 renal scintigraphy at 4 weeks and 6 months following surgery.

Total analgesia was reported in equivalent milligrams of injectable morphine and was calculated for duration of in-patient stay only. Data were maintained and analyzed with File Maker Pro (File Maker Inc, Santa Clara, CA).

RESULTS

Five patients (3 female, 2 male) underwent LSP with a mean follow-up of 15.7 months (range, 7 to 24). Average age of the patients was 42.8 years (range, 33 to 64) with an average body mass index of 29.3 kg/m^2 (range, 19.3 to 54.9). Three patients had right UPJO, 2 had left UPJO. None had undergone a previous procedure for the repair of obstruction. However, all patients had indwelling ureteral stents placed before the time of surgery. Mean split renal function for the obstructed kidney by Tc-99m MAG3 scan was 36% (range, 15 to 52) **(Table 1)**. Three patients were noted to have a crossing vessel, while the other 2 patients had dense, fibromuscular adhesions surrounding the UPJ. Laparoscopic repair was transposed in all cases with crossing vessels. Mean operative time and estimated blood loss were 196 minutes (range, 145 to 284) and 50 mL (range, 10 to 150), respectively. Average time to regular diet was 13.3 hours (range, 5 to 35). Mean durations of postoperative urinary catheter and abdominal drain were 0.9 days (range, 0.5 to 1.5) and 1.6 days (range, 1 to 2.5), respectively. Similarly, mean length of hospital stay was 1.6 days. One patient was kept in the hospital one extra day due to difficulty voiding after catheter removal. Mean analgesia consumption was 42.1 mg (range, 21 to 65) of equivalent morphine.

No intraoperative complications were noted. One perioperative complication occurred. This involved patient #5 in

Table 1.
Summary of Preoperative and Postoperative Tc-99m MAG3 Renal Scans

Pt #	UPJO* Side	Age/Sex	Preoperative			4 Week Postoperative			6 Month Postoperative		
			OR Finding	MAG3 Split Function	T 1/2 (min)	Symptoms	MAG3 Split Function	T 1/2 (min)	Symptoms	MAG3 Split Function	T 1/2 (min)
1	R	38/F	CV	52	14	None	51	6	None	49	5
2	R	64/F	DA	36	>60	None	36	26	None	40	16
3	R	33/M	CV	45	>60	None	50	11	None	48	9
4	L	37/F	DA	15	43	None	17	24	None	19	20
5	L	42/M	CV	32	37	None	40	13	None	40	14

*UPJO = ureteropelvic junction obstruction; CV = crossing vessel; DA = dense adhesion.

our series who was a 42-year-old male with a left-sided UPJO. The night of the surgery, the patient complained of colic-type flank pain with intractable nausea and vomiting. A retrograde pyelogram was performed on the morning of POD 1, which demonstrated a normal caliber ureter with mild hydronephrosis. No extravasation of contrast occurred, and the UPJ anastamosis was patent. Although there was no obvious evidence of obstruction, a 6F ureteral stent was placed without difficulty. Multiplanar fluoroscopic views ensured proper placement of the guidewire and stent in the collecting system. The patient noted complete resolution of symptoms, however, did note moderate irritatitve voiding symptoms requiring anticholinergic medications and flank discomfort while voiding during his recovery period. Four weeks thereafter, the ureteral stent was removed. No further complications were observed 7 months postoperatively.

Follow-up split function with MAG-3 renal scans at both 4 weeks and 6 months following LSP were not significantly different from preoperative values **(Table 1)**. Otherwise, all patients remained asymptomatic throughout their follow-up period with no evidence of obstruction. One patient experienced transient right flank-region pain 10 months postoperatively. This discomfort lasted only a few days and quickly resolved. Abdominal ultrasound at that time revealed no hydronephrosis, however, did demonstrate several gallbladder stones. Follow-up scan at that time noted drainage with T-1/2 of 26 minutes, which had improved from the patient's preoperative state of complete obstruction. A more recent renal scan 18 months postoperatively demonstrated a further improvement in T1/2 of 16 minutes and a stable split renal function, with no recurrence of flank discomfort. In addition, this patient, the only one with preoperative baseline renal insufficiency, had an improvement in serum creatinine from 2.5 mg/dL to 2.0 mg/dL. To date, all patients have no pain or symptoms secondary to recurrent UPJO.

DISCUSSION

Ureteral stenting in children typically requires a second procedure with the patient under anesthesia for stent removal. The case for nonstented pyeloplasty has been addressed in a review study of the pediatric literature where it has been shown to be safe and accepted as a standard of care.[5]

In general, the indications for ureteral stenting are many, and their use has become common in a urologic practice, especially after a pyeloplasty where a ureteral stent typically will be placed for 4 weeks to 6 weeks postop.[34] The most recent and largest published series to date, from Johns Hopkins, documents 4-week routine stenting following laparoscopic pyeloplasty.[15] Unfortunately, stent use is not without potential complication. In one study evaluating the morbidity of stents, a complication rate of 94% (103/110 patients) was reported, which included infection, flank pain with voiding, stent migration, and stent fragmentation.[31] Similarly, using validated questionnaires, Joshi et al[32] reported that 78% of the 62 respondents noted bothersome urinary symptoms that encompassed urinary urgency, frequency, incontinence, and hematuria. In addition, 80% of respondents experienced stent-related pain affecting daily activities, as well as some respondents noting sexual dysfunction (32%) and reduced work capacity (58%).[11] In the senior surgeon's prior experience with 17 stented laparoscopic pyeloplasties, 13 patients (77%) complained of irritative voiding symptoms. Nine (53%) of these individuals required anticholinergic medication to

treat these symptoms and 2 (12%) required early stent removal 3 weeks postoperatively (unpublished data).

In our initial LSP experience, we found no increased morbidity from performing this technique. The risks of stent migration, encrustation, stent syndrome (defined as dysuria, frequency, flank pain, and hematuria commonly seen with short-term placement), increased risk of infection, and stent encrustation were replaced by the risk of possible postop obstruction and/or urinoma formation that would require retrograde stent placement. Such a maneuver is potentially dangerous in that wire placement may injure the anastamosis or be mistakenly placed outside the collecting system. Proper endoscopic equipment (eg, hydrophilic coated guidewire) and skill are required to ensure safe placement. In our study, only one patient experienced symptoms suggestive of postoperative obstruction. Retrograde pyelography, however, failed to demonstrate obstruction. Nevertheless, a ureteral stent was placed for 4 weeks, during which time, the patient complained of irritative voiding symptoms and renal pain during voiding. Furthermore, the oldest patient in this cohort (patient #2) with a BMI of 54.9 kg/m^2 who had recurrent bouts of pyelonephritis and flank pain at the time of presentation had dense peri-ureteral adhesions noted at the time of surgery. This patient with a preoperative split function of 35% on the right side, and complete UPJO was noted to have a partial obstruction on follow-up renal scan. At 10-months postoperatively, the patient experienced a 1-week bout of transient flank pain for several months. Ultrasonography and a repeat renal scan study excluded recurrent UPJO. The concept of cholecystitis was considered by the presence of gallbladder stones and sludge coupled with moderate gallbladder wall thickening. This patient has otherwise remained asymptomatic with improved serum creatinine and no recurrent bouts of pyelonephritis despite moderate objective improvement. We did not experience any anastomotic leaks based on abdominal drain outputs. No infectious or obstructive complications related to the use of Lapra-Ty clips were encountered.[35] Although postoperative CT-abdominal scans were not routinely obtained, none of the patients exhibited signs or symptoms consistent with urinoma formation, which compares favorably with a previous report that noted a 5% prolonged urinary leak and 5% rate of urinoma formation in a nonstented pediatric cohort.[5]

The benefits of a stentless procedure, if proven as efficacious and safe as a stented pyeloplasty, include reducing the risk for infection, eliminating the risk of developing stent syndrome and the need for follow-up cystoscopy 4 weeks to 6 weeks postoperatively for stent removal. This may ultimately prove to be less traumatic for the patient.

The technical advantage of using the LSP technique is the avoidance of stent interference during suture-related reconstruction. LSP allows for optimal visualization and direct access to the spatulated edges for anastamosis, eliminating the risk of entangling the suture around the stent and stent migration. As such, these factors help optimize the likelihood of a watertight anastamosis. Comparative results were noted to our previously published stented laparoscopic pyeloplasty series.[17] Comparing our operative times to times of previously published series shows that our mean time of 196 minutes is comparable to that of other contemporary large series, which range between 123 minutes and 252 minutes.[13–27] When assessing hospitalization, we noted a shorter mean stay of approximately 1.6 days versus that of other series, which are reported to be between 2.6 days to 4.5 days.[13–16]

Overall, there was 100% subjective success in our 5 patients with a mean follow-up of 15.7 months. With regards to objective success, all patients demonstrated stabilized or improved split renal function on MAG-3 renal scan and improved drainage T-1/2 times.

We are cautiously optimistic about these results. Several limitations of this study warrant discussion. The small patient number and short follow-up limit the power to perform statistical analysis. Although some critics may argue that extended follow-up beyond 24 months would be optimal, Inagaki et al[15] from Johns Hopkins evaluated 147 LPs with a mean follow-up of 24 months and demonstrated that most failures occur within 6 months. Due to small numbers in a retrospective review, we were not able to assess the benefit of LSP for primary versus secondary UPJO. A prospective, randomized study comparing stented with nonstented methods is needed to address the dogma of ureteral stent placement and evaluate the postoperative complication parameters. As such, it will take a significantly larger cohort of patients with a longer follow-up to assess whether adult LSP is comparable to published success rates of stented laparoscopic pyeloplasty of 81 to 99.[13–16] Currently, the standard of care remains to place a stent after ureteral repair. We still advocate the use of a stent in all patients with a solitary kidney, patients with a difficult ureteral anastomosis, significant bleeding during UPJO repair, and those individuals with a thick, noncompliant ureter due to chronic inflammation.

CONCLUSION

Utilizing a stentless technique has proved to be efficacious in a small cohort of patients with limited follow-up. Our minimal incidence of postoperative complications is likely related to meticulous surgical technique and ability to minimize laxity on our suture line with the aid of additional Lapra-Ty clips as needed. Certainly, a larger cohort with longer follow-up will be required to prove the durability and safety of a stentless laparoscopic pyeloplasty, which may ultimately revolutionize previous dogmatic assertions.

References:

1. Anderson JC, Hynes W. Retrocaval ureter: a case diagnosed preoperatively and treated successfully by a plastic operation. *Br J Urol.* 1949;21:209–210.

2. Notley RG, Beaugie JM. The long-term follow-up of Anderson-Hynes pyeloplasty for hydronephrosis. *Br J Urol.* 1973;45: 464–467.

3. Persky L, Krause JR, Boltuch RL. Initial complications and late results in dismembered pyeloplasty. *J Urol.* 1977;118:162–165.

4. Brooks JD, Kavoussi LR, Preminger GM, Schuessler WW, Moore RG. Comparison of open and endourologic approaches to the obstructed ureteropelvic junction. *Urology.* 1995;46:791–795.

5. Smith KE, Holmes N, Lieb JI, Mandell J, Baskin LS, Kogan BA. Stented versus nonstented pediatric pyeloplasty: a modern series and review of the literature. *J Urol.* 2002;168:1127–1130.

6. Shalhav AL, Giusti G, Elbahnasy AM, et al. Adult endopyelotomy: impact of etiology and antegrade versus retrograde approach on outcome. *J Urol.* 1998;160:685–689.

7. Kim FJ, Herrell SD, Jahoda AE, Albala DM. Complications of Acucise endopyelotomy. *J Endourol.* 1998;12:433–65.

8. Gerber GS, Kim JC. Ureteroscopic endopyelotomy in the treatment of patients with ureteropelvic junction obstruction. *Urology.* 2000;55:198–202.

9. Lam JS, Cooper KL, Greene TD, Gupta M. Impact of hydronephrosis and renal function on treatment outcome: antegrade versus retrograde endopyelotomy. *Urology.* 2003;61:1107–1111.

10. Desai MM, Gill IS, Carvalhal EF, et al. Percutaneous endopyeloplasty: a novel technique. *J Endourol.* 2002;16:431–443.

11. Gill IS, Desai MM, Kaouk JH, Wani K, Desai MR. Percutaneous endopyeloplasty: description of new technique. *J Urol.* 2002; 168:2097–2102.

12. Ost MC, Kaye JD, Guttman MJ, Lee BR, Smith AD. Laparoscopic pyeloplasty versus antegrade endopyelotomy: comparison in 100 patients and a new algorithm for the minimally invasive treatment of ureteropelvic junction obstruction. *Urology.* 2005;66:47–51.

13. Atug F, Burgess SV, Castle EP, Thomas R. Role of robotics in the management of secondary ureteropelvic junction obstruction. *Int J Clin Pract.* 2006;60:9–11.

14. Adeyoju AB, Hrouda D, Gill IS. Laparoscopic pyeloplasty: the first decade. *BJU Int.* 2004;94:264–267.

15. Inagaki T, Rha KH, Ong AM, et al. Laparoscopic pyeloplasty: current status. *BJU Int.* 2005;95:102–105.

16. Link RE, Bhayani SB, Kavoussi LR. A prospective comparison of robotic and laparoscopic pyeloplasty. *Ann Surg.* 2006; 243:486–491.

17. Shalhav AL, Orvieto MA, Chien GW, Mikhail AA, Zagaja GP, Zorn KC. Minimizing knot tying during reconstructive laparoscopic urology. *Urology.* 2006;68:508–513.

18. Moore RG, Averch TD, Schulam PG, Adams JB, Chen RN, Kavoussi LR. Laparoscopic pyeloplasty: experience with the initial 30 cases. *J Urol.* 1997;157:459–462.

19. Recker F, Subotic B, Goepel M, Tscholl R. Laparoscopic dismembered pyeloplasty: preliminary report. *J Urol.* 1995;153: 1601–1604.

20. Pattaras JG, Moore RG. Laparoscopic pyeloplasty. *J Endourol.* 2000;14:895–904.

21. Janetschek G, Peschel R, Bartsch G. Laparoscopic Fenger plasty. *J Endourol.* 2000;14:889–893.

22. Soulie M, Salomon L, Patard JJ, et al. Extraperitoneal laparoscopic pyeloplasty: a multicenter study of 55 procedures. *J Urol.* 2001;166:48–50.

23. Eden CG, Cahill D, Allen JD. Laparoscopic dismembered pyeloplasty: 50 consecutive cases. *BJU Int.* 2001;88:526–31.

24. Baldwin DD, Dunbar JA, Wells N, McDougall EM. Single-center comparison of laparoscopic pyeloplasty, Acucise endopyelotomy, and open pyeloplasty. *J Endourol.* 2003;17:155–60.

25. Sundaram CP, Grubb RL, Rehman J, et al. Laparoscopic pyeloplasty for secondary ureteropelvic junction obstruction. *J Urol.* 2003;169:2037–2040.

26. Jarrett TW, Chan DY, Charambura TC, Fugita O, Kavoussi LR. Laparoscopic pyeloplasty: the first 100 cases. *J Urol.* 2002; 167:1253–1256.

27. Türk IA, Davis JW, Winkelmann B, et al. Laparoscopic dismembered pyeloplasty – the method of choice in the presence of an enlarged renal pelvis and crossing vessels. *Eur Urol.* 2002;42: 268–275.

28. Gerber GS, Stockton BR. Use of stents after ureteroscopic stone removal. *J Endourol.* 2006;20:383–385.

29. Lawrentschuk N, Russell JM. Ureteric stenting 25 years on: routine or risky? *Aust N Z J Surg.* 2004;74:243–247.

30. Somers WJ. Management of forgotten or retained indwelling ureteral stents. *Urology.* 1996;47:431–435.

31. Richter S, Ringel A, Shalev M, Nissenkorn I. The indwelling ureteric stent: a 'friendly' procedure with unfriendly high morbidity. *BJU Int.* 2000;85:408–411.

32. Joshi HB, Stainthorpe A, MacDonagh RP, Keeley Jr FX, Timoney AG. Indwelling ureteral stents: evaluation of symptoms, quality of life and utility. *J Urol.* 2003;169:1065–1069.

33. Soria F, Rioja LA, Blas M, Duran E, Uson J. Evaluation of the duration of ureteral stenting following endopyelotomy: Animal study. *Int J Urol.* 2006;13:1333–1338.

34. Chew BH, Knudsen BE, Denstedt JD. The use of stents in contemporary urology. *Curr Opin Urol.* 2004;14:111–115.

35. Finley DS, Perer E, Eichel L, et al. Ureteral pseudodiverticulum associated with absorbable suture clips after laparoscopic pyeloplasty: case report. *J Endourol.* 2005;19:726–729.